THE

# YOUNG MECHANIC.

## SEPTEMBER, 1833.

### CHEMISTRY.

#### WATER.

Rain Water.—No natural water exists in a state of absolute purity; that which approaches the nearest to it is rain water. This always contains air and carbonic acid;* nitric and hydrochloric acids, and lime, have also been detected.† Beside these it contains numerous other foreign substances, which, previous to the shower, were floating in the air, and which combine with it while falling to the earth. In some instances the quantity and appearance of these substances has been such as to attract particular notice, alarming the fears of the superstitious, and giving rise to many marvellous reports, such as the raining of blood, dust, stones, &c. The presence of these substances is to be attributed in most cases to wind, and in some, to volcanic eruptions. The red snow of the Alps has attracted considerable attention, and careful analysises have been made, from which it is inferred that its color is owing to a red vegetable matter. In some specimens the presence of per-oxide of iron is sufficient to account for this peculiarity.

Mineral Waters.—Great differences exist, in the water of different places, both in degree of purity and in the nature of the foreign substances which they hold in solution, or in suspension. Those which contain mineral substances in considerable quantity are distinguished by the general term mineral waters. They occur in

* It is remarkable that this air is very rich in oxygen; that procured from snow water, was found by Gay, Lussac and Humbolt to contain 34·8, and that from rain water 32 per cent.

† M. Liebic examined 77 specimens of rain water, 17 of which were produced during storms; all the latter contained nitric acid in different quantities.

different parts of the earth, constituting wells, springs, or fountains, many of which attracted the attention of mankind at a very early period, and were then, as now, employed both externally and internally for the cure of diseases. Beside great differences in their composition, there is a great diversity in their temperature, some being the same as surrounding bodies, while in others it is as high as 212° F.

In nearly all mineral waters there is some substance, which from its greater activity or quantity, gives a character to the water; this has occasioned a division into the following classes.

1. *Acidulous Waters.*—These contain a considerable proportion of *carbonic acid* in a free state; they may be distinguished by their acid taste.

2. *Chalybeate Waters.*—These contain *iron*, usually held in solution by carbonic acid. They possess a strong styptic taste, and are blackened by an infusion of nutgalls. In waters of this class the carbonic acid is sometimes in such excess as to communicate acid properties forming a sub-division called *Acidulous Chalybeate.*

3. *Hepatic* or *Sulphureous Waters.*—These contain *sulphuretted hydrogen*, most frequently uncombined; they are easily distinguished by their smell, and by the property which this gas possesses, of blackening silver and lead.

4. *Saline Waters.*—These contain only salts in solution. They contain no free-carbonic acid, sulphuretted hydrogen or iron.

The following is a list of substances hitherto found in mineral waters.

1. Air,
2. Oxygen,
3. Nitrogen,
4. Carbonic acid,
5. Sulphureous acid,
6. Boracic acid,
7. Sulphuret'd hydrogen,
8. Soda,
9. Silica,
10. Lime
11. Sulphate of Soda,
12. " of Ammonia,
13. " of Lime,
14. Sulphate of Magnesia,
15. " of Alumina,
16. " of Iron,
17. " of Copper,
18. Nitrate of Potash,
19. " of Lime,
20. " of Magnesia,
21. Muriate of Potash,
22. " of Soda,
23. " of Ammonia,
24. " of Baryta,
25. " of Lime,
26. " of Magnesia,
27. Muriate of Alumina,
28. " of Manganese,
29. Carbonate of Potash,
30. " Soda,
31. " of Ammonia,
32. " of Lime,
33. " of Magnesia,
34. " of Alumina,
35. " of Iron,
36. Hydrosulphuret of Lime,
37. " of Potash,
38. Borate of Soda.

Beside the substances above enumerated, animal and vegetable matters are also occasionally to be met with in mineral waters, but these may be considered as accidental.

The following description of some of the principal mineral waters, which have been subjected to examination, will serve to show their uses and importance, and also the salts which most commonly associate in them. The importance of an investigation of the various waters of the globe will be admitted, when we consider that not only the quality of the articles prepared by numerous manufactures, but the differences observable in the salubrity of different places, are in a great degree dependant upon the quality of

the water consumed; and that it is to such investigations that many of us are indebted for our health or our lives, and many cities and villages for their wealth and prosperity.

Aix-la-Chapelle or *Aken Waters*.—The thermal or warm sulphureous waters of the city of Aix-la-Chapelle in Germany, have long held a distinguished place among the mineral springs of Europe, and have contributed considerably to the opulence and celebrity of the place. The principal spring is enclosed in a square stone cistern the upper part of which is vaulted, and contracted in its dimensions. A considerable quantity of sulphur sublimes from the water and collects upon the upper part of the cistern in the form of fine powder, from whence it is, from time to time, collected and sold under the name of *Aix Sulphur*. The temperature of the water is about 143° Fah. When fresh from the spring it is clear, and possesses a strong sulphurous and foetic odor; but upon standing it loses its smell, becomes turbid, and deposits a calcareous sediment. It is soft to the touch and somewhat saponaceous, producing lather to a slight degree when agitated. The effects of this water as a medicine, are very striking. Its immediate operation when drank in moderate quantity raises the spirits. It afterwards proves diuretic, and increases perspiration. It is used also externally as a bath to soften the rigidity left by gout and rheumatism, to stimulate cold and paralytic limbs, and for the cure of many cutaneous disorders. Its saponaceous quality, and more particularly its temperature, render it valuable for fulling and cleansing wool and linen, and other processes in art where water is required.

The following is Bergman's analysis of the Aix-water:

| | | |
|---|---|---|
| Water, | 8940, | |
| Sulphuretted hydrogen, | 13·06, | cub. in. |
| Carbonate of Soda, | 15·25, | |
| " of Lime, | 5·93, | |
| Muriate of Soda, | 6·21. | |

This water has been imitated by passing sulphuretted hydrogen gas through a hot and very weak alkaline water.

Balaruc Waters.—These are hot springs of some celebrity in the town of Balaruc in France. They are limpid and saltish to the taste. Their temperature is about 128° Fah. They belong to the class of saline thermal waters, and are used both externally and internally for the cure of diseases.

One thousand grains contain, according to Orfila,

| | | |
|---|---|---|
| Carbonic Acid, | 36 | cub. in. |
| Carbonate of Lime, | 7 | gr. |
| " of Magnesia, | 0·55, | |
| Hydrochlorate of Soda, | 45·05, | |
| " of Lime, | 5·45, | |
| " of Magnesia, | 8·25, | |
| Sulphate of Lime, | 4·20. | |
| A trace of Iron, | | |

Bath Waters.—The city of Bath, in Somersetshire, England, has long been celebrated for its saline thermal waters. There are three principal sources affording an abundant and invariable supply. The temperature of the hottest of these is uniformly 116°, and that of the coldest 112° F., and they remain the same during the year. The taste of Bath water is simply hot and chalybeate, and what is remarkable is, that it loses this taste upon standing before any sensible precipitation of the iron takes place. The diseases for which it has been recommended are numerous. As a remedy for the gout, rheumatism paralysis of the limbs, and diseases of the urinary organs, it has long been celebrated. Its external application may be traced back to a very early period; by some it is pretended to have been in use 800 years before Christ.

In an analysis by Mr. Phillips, one pint was found to contain

| | |
|---|---|
| Carbonic Acid, | 1·2 cub. in. |
| Sulphate of Lime, | 9 grains, |
| Hydrochlorate of Soda, | 3·3 " |
| Sulphate of Soda, | 1·5 " |
| Carbonate of Lime, | 0·8 " |
| Silex, | 0·2 " |
| Oxide of Iron, | 0·0147 " |

Brighton Water.—The town of Brighton, England, says a celebrated writer, 'may attribute its popularity to Dr. Richard Russell, who having settled here, wrote a treatise on the importance of sea-bathing, and successfully recommended the practice in scrophulous and glandular complaints. He caused a valuable mineral spring at Wick, about one mile from the place, to be opened, &c.'

This spring is chalybeate, and according to Dr. Marcet one pint contains

| | |
|---|---|
| Carbonic Acid, | 2·5 cub. in. |
| Sulphate of Iron, | 1·80 gr. |
| " of Lime, | 4·09, |
| Hydrochlorate of Soda, | 1·53, |
| " of Magnesia, | 0·75, |
| " of Silex, | 0·14, |
| Loss, | 0·19 |

Bristol Hotwells.—A simple thermal water in the city of Bristol, England. It is without odor, perfectly limpid and sparkling, and sends forth air-bubbles when poured into a vessel. Its specific gravity is 1 00077. The temperature upon an average is about 74° F. It was formerly much celebrated in consumption, but its beneficial effects in this disease have been justly called in question. According to Dr. Carrick's analysis one pint contains

| | |
|---|---|
| Carbonic Acid, | 3·75 cub. in. |
| Air, | 0·375 " " |
| Hydrochlorate of Magnesia, | 0·9 grains, |
| " of Soda, | 0·5 " |
| Sulphate of Soda, | 1·4 " |
| " of Lime, | 1·47 " |
| Carbonate of Lime, | 1·63 " |

Buxton Waters.—The town of Buxton, in Derbyshire, England, has been much celebrated for its mineral waters for more than two hundred years, and has been for that period resorted to by large numbers on this account. Indeed, from the ruins of an ancient bath and some capacious leaden cisterns which have been found there, it is apparent that they were in use at a very early period, though there is no record of their being in use in the middle ages. The waters are now conveyed from the springs into baths in a building constructed for the purpose. The springs, it is estimated, throw up about sixty gallons of water every minute. A white marble basin called St. Anne's Well, is resorted to, usually, to obtain the water for drinking; it is remarkable from the circumstance that hot and cold spring water may be obtained, within one foot of each other, from a double pump, in the building which contains it. The Buxton water is perfectly clear and colorless, entirely void of smell and nearly of taste. The temperature is about 82° F. uniformly in all seasons. It possesses, notwithstanding its celebrity, no remarkable medicinal properties. It is employed largely both externally and internally. Its temperature and the great abundance of the supply, render it of great value as a bath. It is used for cooking and other domestic purposes at the houses in the vicinity. Its composition, according to Dr. Pearson, is,

| | |
|---|---|
| Water, | 58309 gr. |
| Nitrogen, | 2 cub. in. |
| Carbonate of Lime, | 10·5 gr. |
| Sulphate of Lime, | 2·5, |
| Hydrochlorate of Soda, | 1·5. |

Carlsbad or Caroline Waters.—These very celebrated and singular acidulo-chalybeate thermal springs are situated in Carlsbad, Bohemia. There are several springs within a small compass, of which the principal one, called the *Prudel* (or furious) issues out violently, in large quantity, through a natural vault or incrustation of stalactite which it has formed by long deposition. The temperature of this fountain is invariably 165° F. Some of the other springs are only 120° to 125° Fah. The taste of the water is strongly alkaline, bitter, and strongly chalybeate. It has scarcely any odor. This water is remarkable for a very rapid deposition of carbonate of lime as it cools, which forms a very hard incrustation upon wood, moss, and other articles which are exposed to it for that purpose, and will afterwards sustain a high polish, presenting a variegated surface, occasioned by the iron precipitating with the carbonate of lime, which is very beautiful. The Carlsbad waters, beside their use in the cure of disorders, are valuable for the salt which they contain. The only one, however, which is manufactured from them is sulphate of soda. According to Dr. Beecher's estimate, the main spring alone throws out annually, equal to 746,864 lbs. crystallized carbonate of soda, 1,132,923 lbs. crystallized sulphate of soda, and 238,209 lbs. crystallized muriate of soda.

Klaproth's analysis of water from the principal spring is as follows: 100 cubic inches contain

| | |
|---|---|
| Carbonate of Soda, (dry,) | 39 gr. |
| Sulphate of Soda, | 70·5, |
| Muriate of Soda, | 34·1, |
| Carbonate of Lime, | 12, |
| Silex, | 2·5, |
| Oxide of Iron, | 0·1, |
| Carbonic Acid, | 32 cub. in. |

CHELTENHAM WATERS.—To these waters, the town of Cheltenham, England, probably owes more of its celebrity than to any other circumstance. The medicinal properties of the water were discovered in the year 1716, since which time its beneficial effects have proved an increasing source of wealth to the place. Salts are obtained from it and sold under the name of *Cheltenham salts*. It is a saline chalybeate water, and its composition, according to Fothergill, is as follows,

| | |
|---|---|
| Water, | 103643 gr. |
| Carbonic Acid, | 30·368 cub. in. |
| Nitrogen, | 15 " " |
| Carbonate of Iron, | 5, |
| Hydrochlorate of soda, | 5, |
| " of Magnesia and Sulphate of Magnesia, | 25, |
| Sulphate and Carbonate of Soda, | 430, |
| Sulphate of Lime, | 40, |

HAMPSTEAD WATER.—This is a chalybeate spring in Hampstead, England, and was formerly much celebrated. According to Mr. Bliss, one gallon contains

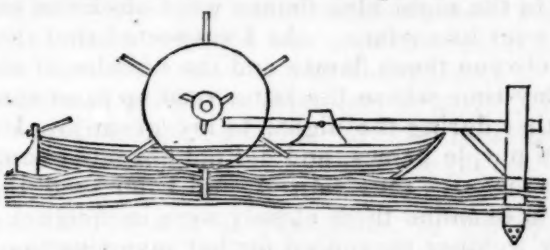
| | |
|---|---|
| Carbonic Acid, | 10·1 cub. in. |
| Air, | 90·9 " " |
| Oxide of Iron, | 1·5 grains, |
| Hydrochlorate of Magnesia, | 1·75, |
| Sulphate of Lime, | 2.12, |
| Hydrochlorate of Soda, | 1·, |
| Silex, | 0·38, |

HARROWGATE WATERS.—There are several saline sulphureous springs in the town of Harrowgate, England, which from their medicinal properties have given to it considerable publicity. One of them discharges, the most strongly impregnated, sulphurous water of any in the kingdom, and is much used as a bath for dropsical, scorbutic and cutaneous disorders. The composition of the two principal springs is a follows:

| *Old Well Temp. 69° F.* | | *Oddie's Temp. 50° F.* | |
|---|---|---|---|
| Carbonic Acid, | 65 cub. in. | Carbonate Soda, | 84 gr. |
| Sulphuretted hydrogen, | 8, | " of Magnesia, | 1, |
| Nitrogen, | 8, | Sulphate of Lime, | 23, |
| Carburretted hydrogen, | 58, | Hydrochlorate of Soda, | 37·5, |
| Carbonate of Soda, | 1·84, gr. | " of Lime, | 2·75, |
| Hydrochlorate of Soda, | 9·2, | " of Magnesia, | 1·23, |
| " of Lime, | 8·9, | Oxide of Iron, | 3, |
| " of Magnesia, | 5·4, | Total of Saline matter, | 42·95. |
| Total of Saline matter, | 108·14, | | |

## REMOVING ROCKS FROM RIVERS.

Amongst natural operations perpetually altering the surface of our globe, there are some which it would be advantageous to accelerate. The wearing down of the rocks which impede the rapids of navigable rivers is one of this class. A very beautiful process for accomplishing this object has been employed in America. A boat is placed at the bottom of the rapid, and kept in its position by a long rope, which is firmly fixed on the bank of the river near the top. An axis, having a wheel similar to the paddle-wheel of a steamboat fixed at each end of it, is placed across the boat; so that the two wheels and their connecting axis shall revolve rapidly, being driven by the force of the passing current. Let us now imagine several beams of wood shod with pointed iron fixed at the ends of strong levers, projecting beyond the bow of the boat, as in the annexed representation:



If these levers are at liberty to move up and down, and if one or more projecting pieces, called cams, are fixed on the axis opposite to the end of each lever, the action of the stream upon the wheels will keep up a perpetual succession of blows. The sharp-pointed shoe, striking upon the rock at the bottom, will continually detach small pieces, which the stream will immediately carry off. Thus, by the mere action of the river itself, a constant and most effectual system of pounding the rock at its bottom is established. A single workman may, by the aid of a rudder, direct the boat to any required part of the stream; and when it is necessary to move up the rapid, as the channel is cut, he can easily cause the boat to advance by means of a capstan.

When the object of the machinery just described has been accomplished, and the channel is sufficiently deep, a slight alteration converts the apparatus to another purpose almost equally advantageous. The stampers and the projection pieces on the axis are removed, and a barrel of wood or metal, surrounding part of the axis, and capable, at pleasure, of being connected with or disconnected from the axis itself, is substituted. The rope which hitherto fastened the boat is now fixed to this barrel; and if the barrel is loose upon the axis, the paddle-wheels make the axis only revolve, and the boat remains in its place: but the moment the

axis is attached to its surrounding barrel, this begins to turn, and winding the rope upon itself, the boat is gradually drawn up against the stream, and may be employed as a kind of tug-boat for all the vessels which have occasion to ascend the rapid. When the tug-boat reaches the summit, the barrel is released from the axis, and friction being applied to moderate its velocity, the boat is allowed to descend. BABBAGE.

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## IGNIS FATUUS.

The first time I saw the Ignis Fatuus, or Will-with-the-Wisp, was in a valley in the Forest of Gorbitz, in the Newmark. This valley cuts deeply in compact loam, and is marshy on its lower part. The water of the marsh is ferruginous, and covered with an iridescent crust. During the day bubbles of air were seen rising from it, and in the night blue flames were observed shooting from and playing over its surface. As I suspected that there was some connexion between these flames and the bubbles of air, I marked during the day-time where the latter rose up most abundantly, and repaired thither during the night; to my great joy I actually observed bluish purple flames, and did not hesitate to approach them. On reaching the spot they retired, and I pursued them in vain; all attempts to examine them closely were ineffectual. Some days of very rainy weather prevented further investigation, but afforded leisure for reflection on their nature. I conjectured that the motion of the air on my approaching the spot, forced forwared the burning gas, and remarked, that the flame burned darker, when it was blown aside; hence I concluded that a continuous thin stream of inflammable air was formed by these bubbles, which, once inflamed, continued to burn—but which, owing to the paleness of the light of the flame, could not be observed during the day.

On another day, in the twilight, I went again to the place, where I awaited the approach of night: the flames became gradually visible, but redder than formerly, thus showing that they burnt also during the day: I approached nearer, and they retired. Convinced that they would return again to the place of their origin when the agitation of the air ceased, I remained stationary and motionless, and observed them again gradually approach. As I could easily reach them, it occured to me to attempt to light paper by means of them, but for some time I did not succeed in this experiment, which I found was owing to my breathing. I therefore held my face from the flame, and also interposed a piece of cloth as a screen; on doing which I was able to singe paper, which became brown colored and covered with a viscous moisture. I next used a narrow slip of paper, and enjoyed the pleasure of seeing it take fire. The gas was evidently inflammable, and not a

phosphoescent luminous one, as some have maintained. But how do these lights originate? After some reflection I resolved to make the experiment of extinguishing them. I followed the flame; I brought it so far from the marsh, that probably the thread of connexion, if I may so express myself, was broken, and it was extinguished. But scarcely a few minutes had elapsed, when it was again renewed at its source (over the air bubbles) without my being able to observe any transition from the neighboring flames, many of which were burning in the valley. I repeated the experiment frequently, and always with success. The dawn approached, and the flames, which to me appeared to approach nearer to the earth, gradually disappeared.

On the following evening I went to the spot, and kindled a fire on the side of the valley, in order to have an opportunity of trying to interflame the gas. As on the evening before, I first extinguished the flame, and then hastened with a torch to the spot whence the gas bubbled up, when instantaneously a kind of explosion was heard, and a red light was seen over eight or nine square feet of the surface of the marsh, which diminished to a small blue flame, from two and a half to three feet in height, that continued to burn with an unsteady motion. It was therefore no longer doubtful that this ignis fatuus was caused by the evolution of inflammable gas from the marsh.

In the year 1811, I was at Malapane, in Upper Silesia, and passed several nights in the forest, because ignis fatui were observed there. I succeeded in extinguishing and inflaming the gas, but could not inflame paper or thin shavings of wood with it. In the course of the same year I repeated my experiments in the Konski forests, in Poland. The flame was darker colored than usual, but I was not able to inflame either paper or wood shavings with it; on the contrary, their surface became speedily covered with a viscous moisture.

In the year 1812, I spent half a night in the Rubenzahl Garden, on the ridge of the Reisengebrige, close on the Schneekoppe, which constantly exhibits the Will-with-the-Wisp, but having a very pale color. The flame appeared and disappeared, but was so mobile that I could never approach sufficiently near to enable me to set fire to any thing with it.

In the course of the same year I visited a place at Walkenried, in the Hartz, where these lights are said always to occur; they were very much like those of the Newmark, and I collected some of the gas in a flask. On the day after, I found by experiment that it occasioned cloudiness in lime water, a proof of its containing carbonic acid.

I observed accidentally another phenomenon allied to this, at the Porta Westphalica, near Minden. On the third of August, 1814, we played off a fire-work from the summit, to which we had ascended during the dark, and where no ignis fatuus was visible.

But scarcely had we fired off the first rocket, when a number of small red flames were observed around us below the summit, which, however, speedily extinguished—to be succeeded by others on the firing of the next rocket.

These facts induced me to separate the ignis fatui from the luminous meteors, and to free them from all connexion with electricity. They are of a chemical nature, and become inflamed on coming to the atmosphere, owing to the nature of their constitution.

I think it highly probable that the fires that sometimes break out in forests are caused by these lights.

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## PATENTS FOR MASSACHUSETTS.

*Granted in January*, 1833.

From the Journal of the Franklin Institute.

For *Making Pads for Harness, &c.;* Silas Lamson, Sterling, Worcester county, Massachusetts, January 5.

A rod of iron bent into a curved, or crescent-like, form, is to have perforations at each end to receive the terrets, and attach it to the pad. The object of this contrivance is to keep the centre, or connecting part of the pads from the back and withers of the horse, so as by throwing the weight on each side to prevent injury to the ridge of the horse's back. This connecting rod may, it is said, be bent in any desired curve, and instead of iron, other metals may be used. There is no claim made, nor does one appear to be necessary in the present case, as nothing more is described than the thing intended to be patented.

For an improvement in *Machines for Spinning Cotton;* John A. Bradshaw, Foxboro', Norfolk county, Massachusetts, January 18.

In arrangement there is certainly some difference between the spindle which is the subject of this patent, and others previously patented both here and in England, but in principle we cannot discover the slightest. There is a dead spindle with revolving flyers, the spindle is raised and lowered by means of a wave rail, in the usual manner, and it consists of three parts; the lower part reaches up to the lower end of the bobbin; this is drilled down to the depth of five or six inches, to receive a wire which is adapted to it; upon this wire, which projects some inches above the lower section of the spindle, is placed the upper section, drilled also for that purpose; and upon this the bobbin is to be placed. The whirl and shaft of the flyer, which revolves freely on the spindle, is driven in the usual way. Those who are acquainted with the recent improvements in spinning, will at once perceive the identity of action in this and some other spindles.

For *Cast Iron Hubs for Wheels;* Carver Washburn, Bridgewater, Plymouth county, Massachusetts, January 18.

This patent is taken simply for the insertion of ferules, or boxes, of metal of a suitable composition, within the ends of cast iron hubs, and the confining them there by screws. The boxes, it is observed, may be renewed when worn, and that they thus remove the objection of the wearing out of cast iron hubs by the friction of the axletree.

Would not a better mode of removing this objection be the case hardening of the axles? It is well known to mechanists that cast iron and hard steel run with less friction than most other metals, and that lathe collars of cast iron, with hard steel mandrels, wear as little, or less, than hardened steel when used for both.

For an improvement in the mode of *Caking Sugar;* Uriel Smith, Sandisfield, Berkshire county, Massachusetts, January 21.

We are somewhat in the dark about the business of *caking sugar*, and find nothing to enlighten us in the specification; we have concluded, however, that the design is to form maple sugar into cakes in a way more convenient than that hitherto employed. The moulds, it seems, are to be made square, of wood, or metal, and are to be arranged in a square frame. Their sides are to be sloping, that the cake, when formed, may be the more readily removed. This is all we can gather from the description, and lest we might plunge into some fatal error upon the subject, we shall leave all further inferences to be drawn by those who may choose to occupy themselves in this matter.

For a *Felt Washer;* William Cole, Lee, Berkshire county, Massachusetts, January 23.

The felt washer here described consists of a wheel carrying four rounds, like those of a reel. The length of the wheel must be equal to the width of the felt, against the lower side of which it is made to revolve in a direction the reverse of that in which the felt passes, the rounds bearing forcibly against it. A tube of tin, or other metal, is placed on the side of the felt opposite to the revolving washer; a row of holes, contiguous to each other, is made along the side of the tube which presses against the felt, and water being let into this tube, it is discharged through these openings upon the felt. This arrangement, the patentee says, will serve to keep the felt perfectly clean until it is worn out.

For a *Mode of Opening, Closing, and Fastening Window Blinds;* Edwin Keith, Bridgetown, Plymouth county, Massachusetts, January 25.

The contrivance here patented is intended to enable a person to open and close blind shutters, and to cause them to stand at any angle required, without the necessity of raising the window sash. Upon the lower end of the hinged side of the blind, a toothed circular segment is to be firmly fixed, the hinge joint, or pin, being the centre of the circle. An iron shaft which passes through the window frame has an endless screw on its outer end, the threads of which take into the toothed segment. By turning this

on the inside, the blinds may be opened and closed at pleasure.—The claim is to this mode of effecting the object, with the variations of which it is susceptible.

The only objection which we perceive to this plan, is, that, in windy weather, the force upon the segment will be very great, in consequence of its nearness to the fulcrum. To obviate this objection, it would be necessary to make it inconveniently large.

For a machine for *Drilling the Eyes of Axes;* Milton Dexter Whipple, Douglass, Worcester county, Massachusetts, January 31.

This appears to be a well arranged machine, the object of which is the making the eyes of axes perfectly true, and of a size, by means of a drilling or boring apparatus of a peculiar construction. The patent is taken for the machine *as described*, the idea of boring, or drilling the eyes, not being considered as new. The patent taken by Benjamin Smith, on the second of November last, is, in part, for an apparatus for drilling the eyes of axes, but the two do not resemble each other. As the present machine is complex, and dependent altogether upon its peculiar construction, it would require an engraving for its clear explanation.

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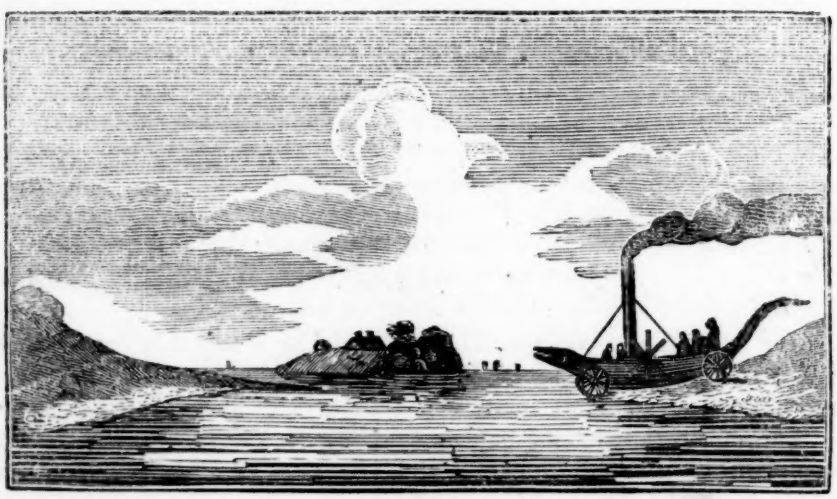
For the Young Mechanic.

## AMPHIBIOUS STEAMER.

Steamer ALLIGATOR entering the water.



IN the last number of the Young Mechanic, I gave a brief description of a Steamer, which I suppose might answer for both land and water. I now send you a drawing to illustrate the thing more clearly. The name I have adopted is the Alligator, and have endeavored to give it somewhat the form of that animal.

PHILO.

## GEOMETRY AND ARITHMETIC.

[Continued from page 122.]

### DECIMAL FRACTIONS.

A decimal fraction has always unity, or one, for its denominator, with as many cyphers annexed as there are places in the fraction; a unit may be supposed to be divided into 10 parts, these will be tenths of a unit; a tenth may be divided into 10 parts, these will be hundredths of a unit; a hundred may be divided into 10 parts, and these will be thousandth parts of a unit; this subdivision may be extended indefinitely.

To express 1-2, the unit need only be divided into 10 parts: 5 tenths equal 1-2.

To express 1-4, the unit must be divided into 100 parts: 25 hundredths equal 1-4.

To express 1-8, the unit must be divided into 1,000 parts: 125 thousandths equal 1-8.

To express 1-16, the unit must be divided into 10,000 parts: 625 10 thousandths equal 1-16th.

Hence the necessity of the unit being divided into very small parts, in order to express some fractions; indeed there are fractions which cannot be expressed exactly by the decimal scale: for this reason many instruments are divided decimally, for when dimensions are taken by a decimal scale, there is no difficulty in expressing the fractions accurately. Decimal fractions are of such a nature, that they vary in the same proportion, and are managed by the same method of operation, as whole numbers are.

All the operations in arithmetic are performed with 10 characters, only 9 of which are significant, or have any value of their own; the cypher is used only to preserve the others in their proper places; they express a value according to their shape, and also their distance from a certain point; it is necessary that this point, or starting place, should be well understood; this point is the unit's place, or right hand figure, where a figure has its simple value according to its shape, but it increases in a tenfold ratio as often as it is removed one place further towards the left hand, thus 8 becomes 80—800, &c., so that any number may be expressed by these 10 characters, however large it may be. But these same 10 characters are made to express parts of a unit, no matter how small the part may be, for as a figure increases in value as it is carried to the left hand, so it must decrease in the same ratio if it be removed to the right. It may be asked, If we put figures to the right of the unit's place, how can we tell which is the unit's figure? this is done by placing a mark between the unit's figure and the first figure of the fraction; thus, if I wish to express $\frac{1}{4}$

decimally, I put a cypher for the unit's place, then a period as a mark, then 2 tenths, then 5 hundredths, thus, 0·25, and call it 25 hundredths, or 1 fourth.

The names of the several places in which the figures stand depend upon their distance to the right or left from the decimal point, and may be understood from the following

TABLE.

| Millions. | 100 Thousands. | 10 Thousands. | Thousands. | Hundreds. | Tens. | Units Place. | Decimal Point. | Tenths place. | Hundredths. | Thousandths. | 10 Thousandths. | 100 Thousandths. | Millionths. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7 | 6 | 5 | 4 | 3 | 2 | 1 | · | 2 | 3 | 4 | 5 | 6 | 7 |

## ADDITION OF DECIMALS.

Addition and Subtraction in decimals are performed in the same manner as whole numbers, care being taken that like parts be placed under one another, and from their sum, or difference, point off as many places for decimals as are equal to the greatest number of decimal places in any of the given numbers.

EXAMPLES.

| | | |
|---|---|---|
| 19·025 | 1·0625 | 123·534 |
| 7·603 | ·31 | 5·6 |
| ·542 | ·246 | ·75 |
| $27·170 | lbs. 1·6185 | galls. 129·884 |

## SUBTRACTION OF DECIMALS.

EXAMPLES.

| | | |
|---|---|---|
| 27·025 | 1·75 | 15·5 |
| 19·673 | ·67 | 7·75 |
| ozs. 7·352 | inch. 1·08 | ft. 7·75 |

## MULTIPLICATION OF DECIMALS.

RULE.—Proceed as in multiplication of whole numbers; then point off as many places of the product for decimals as there are decimals in both the multiplicand and multiplier; but if the product does not consist of as many places, the deficiency must be supplied by prefixing cyphers.*

EXAMPLES.

| | |
|---|---|
| Multiply 6·25 | Multiply 1·625 |
| by ·25 | by ·037 |
| 3125 | 11375 |
| 1250 | 4875 |
| Ans. 1·5625 | Ans. ·060125 |

## DIVISION OF DECIMALS.

RULE.—1. Proceed as in division of whole numbers; then point off as many places of the quotient for decimals as the dividend has decimal places more than the divisor.

2. If the places of the quotient be not as many as the rule requires, supply the defect by prefixing cyphers to the left hand.

3. If at any time there be a remainder, or the decimal places in the divisor be more than those in the dividend, cyphers may be annexed to the dividend or to the remainder, and the quotient carried on to any degree of exactness.

### EXAMPLES.

(1.) 8)231·000 inches in a wine gall.

28·875 inches in a wine pint.

(2.) 8)2150·4 inches in a bushel.

268·8 inches in a dry gall.

(3.)
```
2.75)23·30625(8·475 quotient.
     2200
     ----
     1306
     1100
     ----
     2062
     1925
     ----
     1375
     1375
```

In this example, there being three places of decimals in the dividend *more* than in the divisor, I point off the three right hand figures of the quotient, viz.: ·475 for decimals, according to Rule 1.

(4.)
```
12)0·64896(0·05408 quotient.
     60
     --
     48
     48
     --
     96
     96
```

In this example, there being not so many places in the quotient as there are decimals in the dividend, the defect is supplied by prefixing one cypher, according to Rule 2.

The 4th example may be done by short division, thus: $\left\{\begin{array}{l}12)0\cdot64896\\ \hline 0\cdot05408\end{array}\right.$

## REDUCTION OF DECIMALS.

*To reduce a Vulgar Fraction to its equivalent Decimal.*

RULE.—Divide the numerator by the denominator, and the quotient will be the decimal required. Or, so many cyphers as you annex to the given numerator, so many places must be pointed off in the quotient; and if there be not so many places of figures in the quotient, the deficiency must be supplied by prefixing so many cyphers before the quotient figures.

### EXAMPLES.

1. Reduce 1-8 to a decimal.

```
8)1·000
  -----
  0·125 Ans.
```

2. Reduce 3-8, 5-8, and 2-3 to decimals. Ans. ·375 ·625 ·666+.

*To reduce a decimal to its lowest terms.*—Cast off the cyphers from the right hand.

*To reduce decimals to the lowest denomination.*—Annex cyphers so that they may all have the same number of decimal places.

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* When cyphers are to be placed at the *left hand* of any number, they are said to be *prefixed*, but when they are to be placed at the *right hand*, they are said to be *annexed*.

*Table for reducing Vulgar Fractions to Decimal Fractions.*

| | 2nd. | 3rd. | 4th. | 5th. | 6th. | 7th. | 8th. | 9th. | 10th. | 11th. | 12th. | 13th. | 14th. | 15th. | 16th. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0·5 | 0·333 | 0·25 | 0·2 | 0·166 | 0 142857 | 0·125 | 0·111 | 0·1 | 0 0909 | 0·083 | 0·0769 | 0·071428 | 0 066 | 0 0625 |
| 2 | 1·0 | 0 666 | 0 5 | 0·4 | 0·333 | 0.285714 | 0·25 | 0·222 | 0·2 | 0 1818 | 0·166 | 0 1538 | 0·142857 | 0·133 | 0·125 |
| 3 | | 1·000 | 0·75 | 0·6 | 0·5 | 0·428571 | 0.375 | 0 333 | 0·3 | 0 2727 | 0·25 | 0 2307 | 0·214285 | 0 2 | 0·1875 |
| 4 | . | . | 1·0 | 0 8 | 0·666 | 0·571428 | 0·5 | 0·444 | 0·4 | 0 3636 | 0 333 | 0·3076 | 0 285714 | 0·266 | 0·25 |
| 5 | . | . | . | 1·0 | 0·833 | 0 714285 | 0·625 | 0·555 | 0·5 | 0·4545 | 0·416 | 0 8461 | 0·357142 | 0 333 | 0 3125 |
| 6 | . | . | . | . | 1·000 | 0 857142 | 0.75 | 0·666 | 0·6 | 0 5454 | 0·5 | 0·4615 | 0 428571 | 0·4 | 0·375 |
| 7 | . | . | . | . | . | 1·000000 | 0·875 | 0·777 | 0·7 | 0·6363 | 0 583 | 0·5384 | 0·5 | 0·466 | 0·4375 |
| 8 | . | . | . | . | . | . | 1 000 | 0 888 | 0·8 | 0·7272 | 0·666 | 0·6153 | 0·571428 | 0·533 | 0 5 |
| 9 | . | . | . | . | . | . | . | 1·000 | 0·9 | 0·8181 | 0·75 | 0·6923 | 0 642857 | 0·6 | 0·5625 |
| 10 | . | . | . | . | . | . | . | . | 1·0 | 0·9090 | 0·833 | 0·7692 | 0 714285 | 0·666 | 0·6255 |
| 11 | . | . | . | . | . | . | . | . | . | 1·0000 | 0·916 | 0·8461 | 0·785714 | 0·733 | 0·687 |
| 12 | . | . | . | . | . | . | . | . | . | . | 1·000 | 0 9230 | 0·857142 | 0·8 | 0 75 |
| 13 | . | . | . | . | . | . | . | . | . | . | . | 1 0000 | 0·928571 | 0 866 | 0 8125 |
| 14 | . | . | . | . | . | . | . | . | . | . | . | . | 1·000000 | 0·933 | 0 875 |
| 15 | . | . | . | . | . | . | . | . | . | . | . | . | . | 1·000 | 0·9375 |
| 16 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 1·0000 |

EXPLANATION OF THE TABLE.

THE numerators are in the first or left hand column. And the denominators are placed at the tops of the other columns. In a line with the numerator and under the denominator, the equivalent decimal fraction, thus: 9-12ths.=0·75; and 6-16ths.=0·375.

PHILO.

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## QUESTIONS.

Supposing a hole one foot diameter, to be made entirely through the earth, in the latitude of the State House, Boston, how far beyond the centre of the earth would an ounce bullet pass, dropped from the surface, the hole being supposed to be free from water or other obstruction?

Why does thunder turn milk?